***BEFORE:*** *Wetland Development*
*Bohemia Manor Middle School*
*Cecil County Public Schools*

***AFTER:*** *Completed Wetland*
*Bohemia Manor Middle School*
*Cecil County Public Schools*

## Case Study: Wetlands

A wetland project at Bohemia Manor Middle School in Cecil County was developed from the vision of the 6th grade teaching team. In September 1997, three members of the team attended a workshop given by Environmental Concern, Inc. in St. Michaels, Maryland where they learned how to select and propagate plants for wetlands. With the encouragement and assistance of Rich Mason of the U.S. Fish and Wildlife Service and Laurissa Heller from the Chesapeake Bay Trust they began to plan. A site behind the middle school was selected.

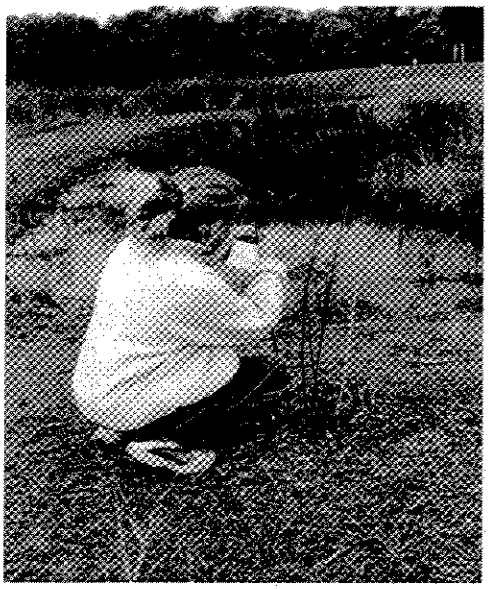
In early January, 1998 one of the team members attended a grant writing workshop. Charlie Hayes and Bill Metcalf of the Cecil Soil Conservation District offered their assistance. The first planning meeting was held in late January, 1998. The Cecil Soil Conservation District agreed to prepare a plan including wetland planting zones, and an observation platform. During the winter months, the team discussed what lessons could be taught using the wetlands as the vehicle.

In math, students drew maps of the proposed wetland and calculated the area of the wetland. In reading, magazines called *Wetlands* were ordered from Kids Discovery. Students read, made bumper stickers, video tapes, and became very knowledgeable about wetlands and their importance to the environment.

With their new knowledge, the science students selected the plants for each wetland zone, and math classes computed the number of plants for each zone and calculated the total cost.

Social studies classes mapped wetlands all over the world and learned the economic and geographical implications and importance of wetlands. In English class, students used what they learned to write a grant to the Chesapeake Bay Trust and letters to local businesses requesting contributions.

Excavation of the wetland began during spring break. When the students returned to school, the wetland was holding water. There were many community people and businesses involved in providing funding,



*Labeling Plants*
*Bohemia Manor Middle School*
*Cecil County Public Schools*

equipment, materials, and labor. A grant for about $900.00 was received from the Chesapeake Bay Trust and used to order plants. A small portion of the grant money was spent for two substitute teachers and on May 19, 1998, 153 6th grade students planted plants in shifts. Rich Mason gave students instruction and was there to answer questions. Local community supporters were there all day.

The wetlands project was a great success. The project helped the environment, taught students and teachers a great deal about wetlands, and joined together the community for a common goal. As educators, the 6th grade team made strides in interdisciplinary education.

The 6th Grade teaching Team at Bohemia Manor Middle School were:

Beth Kirk - Science
Carla Webb - English
Sandy Grimes - Math
Colette McCollum - Reading
Ted Gorzkowski - Social Studies

## Environmental Enhancement

A school wetland is an aquatic laboratory that provides students with hands-on instructional opportunities in all school subjects. Wetlands add interest to the schoolgrounds while providing a source of endless discovery for students.

In addition to being an excellent educational resource, wetlands are a critical habitat for plants and animals. Non-tidal wetlands provide a buffer to streams as they filter, trap and biologically or chemically break down pollutants that run off developed lands and agricultural fields. Wetlands act like a sponge, helping to minimize flooding. Certain wetlands are important for groundwater recharge. Tidal wetlands are especially important as a nursery ground for many fish and shellfish.

Despite all the benefits, wetlands are still being destroyed nationwide at an alarming rate. Over the last 200 years, half of the wetlands in the United States have been eliminated (approximately 100 million acres of wetlands). Citizens, government agencies, and private organizations now realize the importance of wetlands. Since the 1980's a major initiative has been undertaken to restore some of the lost wetland acreage. By preserving and constructing wetlands on school sites, we can help the school community better understand wetlands and be an integral part of this national effort.

There are many different types of wetlands and they are classified by the dominant vegetation type and/or hydrology. An emergent marsh is the most popular type of wetland built on school sites. An emergent marsh is a pond that is shallow enough for plants to emerge from the water surface. Typically, marshes are less then 3' deep. Marshes are dominated by herbaceous plants, such as cattails, with shrubs and small trees on the edges of the flooded portion. In contrast to a marsh, a pond is deeper, and therefore, is primarily open water without plants. For safety reasons alone, a wetland is far superior to a pond in a school setting. Other types of wetlands include forested wetlands, scrub shrub wetlands, wet meadows, bogs, and fens. Depending on site

conditions, there may be an opportunity to construct several wetland types on school grounds. Further discussion in this chapter focuses on designing and constructing an emergent marsh wetland.

# Planning, Design, and Construction

## New Construction and Renovation Projects

An ideal time to incorporate a wetland feature is during the planning of a new building or renovation project. In many cases the requirements for stormwater management can be met by designing a stormwater wetland as opposed to a dry or wet pond. Small pocket wetlands or rain gardens (see page 22) incorporated throughout the site will provide credit to stormwater calculations and can help significantly reduce the size requirements and cost of stormwater management. When engineering the site hydrology, consider using some or all of the water from roofs, parking lots, and fields to create one or many small wetlands. For example, many schools are built with a bus loop island of grass with curb and gutter. To make better use of the bus loop island, design it as a slight depression instead of higher ground. Channel runoff from the driveway and/ or the roof to the island and create a broad shallow marsh. Do not be concerned if the wetland does not hold water year round. Temporary or vernal pools provide vital amphibian breeding habitat and can be planted with an interesting diversity of plants.

## Existing Schools

Many existing school sites are conducive to creating or even restoring wetlands. In order to determine if it is feasible to construct a wetland, begin by examining rainwater runoff. Each site is different and has different opportunities and limitations.

Selecting the proper site is the key to a successful wetland project. The four basic considerations are listed below. In addition, be careful not to alter an existing natural area to construct a wetland. Streams should not be diverted or dammed nor should a woodland be cleared to construct a wetland. Naturally occurring wetlands should never be altered while degraded wetlands can be restored.

**Hydrology** - There needs to be sufficient water feeding the wetland site. It is best to rely on surface runoff to supply the wetland versus groundwater which is usually not reliable due to fluctuations between seasons and from year to year. The volume of runoff will dictate the size of the wetland. See information below on determining runoff volume.

The following bullets address different school site features related to water sources for creating wetlands and offer ideas on how each feature can be used or manipulated for a wetland project.

- Rain water from rooftops and parking lots: These are two reliable sources of water. With rainfall, water runs off and eventually makes its way to a nearby stream. The premise is to intercept some or all of the water by building a shallow depression, a wetland, to hold the water. Channeling water from roofs or from paved surfaces with a curb cut are simple ways to divert rainwater.

- Ditches or swales: Options include plugging or partially plugging a ditch with soil in order to back up water and create a shallow flooded area. This can be done in conjunction with shallow excavation. The sides of a ditch or swale can be pulled back to create a shallow pool. A third option includes diverting water from a ditch with a pipe or open channel to the desired spot and excavating a shallow depression.

- A spring or seep: A spring in an existing woodland or wetland should not be disturbed because these areas often harbor unique or rare plants and animals. If a spring exists that is already disturbed (the side of a mowed hill or field) then capturing the water to build a wetland should not be a problem.

- Wet and muddy areas: For one reason or another certain areas on school grounds remain wet and muddy. If these areas are not jurisdictional wetlands and are not an existing natural area, a shallow excavation can create a vernal (temporary) wetland or, possibly, a perennial (permanent) wetland.

- Storm drains or grates: Grates in fields can be raised or a low earth berm constructed around drains to back up water. Be aware that sand or gravel may have been placed around the concrete riser that supports the grate. If this is the case, several inches of clay soil should be packed on top of the sand and gravel to prevent seepage around the riser. The berm should be constructed of heavy soil to minimize seepage.

- Pipes carrying stormwater: In certain cases, underground pipes carrying stormwater can be tapped diverting the water as a source for a wetland.

- Stormwater management basins: Excavate shallow depressions in dry stormwater basins to intercept and hold water to create small wetland pools. This should not alter the storage capacity of the structure. Excavated soil may need to be hauled off site. In certain cases, wet ponds can be planted with a marsh fringe and an upland buffer. Trees and shrubs should not be planted on the dam side of the structure. Their root system can damage the dam and allow water to penetrate. Work with design engineers for modifications of stormwater basins.

**Slope of Ground** - The more level the area the less earth movement required. If the area has a gentle slope, construct a series of shallow, narrow pools stepping down the slope. Steeper slopes are more difficult to work with.

**Soil** - The higher the silt/clay content of the soil the better. Soils with a silt/clay content over 21% drain slowly and are ideal for ponding water, thereby creating a wetland. A representative from the county Soil Conservation Service can determine if the soil is suitable for constructing a wetland. If the site has well drained soils, a layer of clay can be used as a liner to hold water. **Note:** The entire soil profile does not need to have poorly drained soils to construct a wetland. For example, if at a depth of two feet there is a 3" layer of silty clay then this should be sufficient to slow seepage and create a wetland. Be sure not to dig through this layer during excavation.

**Vegetation** - Students and school staff should be responsible for designing the wetland planting and installing the plants. Student planting plans can be reviewed and edited by a wetland specialist.

## Wetland Design

While a wetland can vary from simple to complex, wetland specialists should be consulted for design and construction. Students can contribute concept designs. Certain secondary school classes may be able to complete a design and construct the project with guidance. While the concept of a wetland is simple, success is achieved by giving attention to details of design, construction, and maintenance.

**Size** - Building the largest wetland possible, given the limitations of the site, is a reasonable goal. Too often schools build a small wetland in areas where a larger project was possible. A larger wetland will allow a more diverse plant and animal community to become established and provide students more opportunities for investigation and discovery. Also, the impact to plants and animals from student use will be less if it is spread over a larger area. Creating several smaller wetland pockets with upland in between is a good option to creating a larger wetland.

Calculating runoff volume is not necessary on small wetlands. If you are unsure about the amount of water or the wetland is large, it may be necessary to calculate runoff volume. Refer to the USDA manual titled *Ponds-Planning, Design, Construction* (local Soil Conservation offices should have a copy). The ideal site has an ample supply of water so that the wetland remains at least saturated throughout the year. However, vernal or seasonal wetlands are an excellent option for drier sites. These wetlands remain wet through the winter and spring and dry out during the summer. Many wetland plants are adapted to this fluctuating water regime. Several species of animals, including many amphibians, are native to vernal pools. The lack of fish predators that eat tadpoles are the main reason many amphibian species seek vernal pools.

**Shape** - An irregular shape is best as it creates a more natural look. An irregular shape will make more nooks and crannies which provide a better habitat and make the wetland more interesting for exploration.

**Depth and Micro-Topography** - An optimal design includes broad shallow areas 0-6'' deep interspersed with pockets varying from 12-24'' deep. Slopes between shallow and deeper pools should be gradual for safety. This design allows emergent wetland vegetation to colonize most of the site with the deeper pockets remaining open. Deeper pools serve as a refuge for amphibians during droughts and also provide habitat for fish. Based on feedback from principals and teachers who have completed wetlands, an open water component is desirable especially from an aesthetic standpoint. If deeper pools cannot be added due to soil limitations or safety reasons, an open water feature can be accomplished by placing large flat rocks along the bottom in a few locations to deter plant growth.

Micro-topography refers to a rough uneven wetland bottom with subtle humocks (islands) and pools. This will allow for the greatest diversity of plant and animal growth.

**Slopes** - For easy access and safety, the upland area leading down to the wetland and the bottom contour of the wetland should be gradually sloped. A slope of about 5:1 or less is desirable.

**Liners** - If the soil in the proposed wetland area is well drained, fine textured (>20% clay) soil can be used to line the site and create poorly drained soils. Clay is a much better option then using a rubber liner. Unlike rubber, clay will not puncture or degrade. The use of clay is usually less expensive and it creates a more natural wetland.

**Stabilizing Slopes** - Slopes and disturbed areas need to be stabilized immediately. Typically, a mix of k-31 fescue and other non-native grasses are used to stabilize soil. While these mixes provide soil stabilization, they provide little habitat and k-31 fescue is an invasive plant. The Natural Resource Conservation Service has developed approved alternative mixes that are native and provide better habitat while stabilizing soil. These include:

- Dams and spillways: 25 lbs/acre each of creeping red fescue, hard fescue, and sheep fescue. Add 5 lbs/acre common white clover.

- Cut slopes or flat ground adjacent to wetland: 20-40 lbs/acre of oats or barley for quick soil stabilization. Add warm season grass/wildflower mix at 10 lbs/acre. A typical mix includes:

Grasses

Little bluestem *Schizachyrium scoparium*
Indiangrass *Sorgastrum nutans*
Switchgrass *Panicum vergatum*

Wildflower (add several of the following; many others are available)

Black-eyed susan *Rudbeckia hirta*
Beebalm *Monarda didyma*
Butterfly milkweed *Asclepias tuberosa*
Common milkweed *Asclepias syriaca*
Goldenrod *Solidago sp.*
Heath aster *Aster pilosus*
Lance leaved coreopsis *Coreopsis lanceolata*
New York aster *Aster novae-belgii*
New England aster *Aster novi-angliae*
Purple coneflower *Echinacea purpurea*
Wild bergamot *Monarda fistulosa*
Wild columbine *Aquilegia canadensis*
Wild blue indigo *Baptisia australis*

Legumes

American vetch *Vicia americana*
Bush clover *Lespedeza capitata*

**Other Features** - Partially submerged logs provide hiding and a basking spot for turtles and frogs. A wooden walkway or dock can be constructed on the edge or through the wetland. An enclosed wildlife observation blind can be built on the edge of the wetland.

## Wetland Construction

**Conserving Topsoil** - Remove the topsoil and set this aside. Complete the excavation, install the liner material, if necessary, then spread the topsoil layer across the bottom of the wetland. Plants will grow much better in topsoil. Topsoil has important organic matter that provides the fuel for plants and the small organisms at the base of the food chain. Organic matter (e.g., mulch, straw) may be added to the wetland bottom and backslopes. Prior to excavation, it may be necessary to roto-till or disc the sod if it is a dense mat.

**Topography** - Most equipment operators take pride in building smooth even pond bottoms. Be sure to convey to the contractor that the bottom is to be rough and uneven.

**Erosion Control** - Erosion control fabric should be used in spillways or swales where moving water could erode soils. Mats of sod can be scraped off the excavation site, then used in place of erosion control fabric. Wetland vegetation should be planted for long term erosion control.

**Liners** - If a clay liner is used, the clay should be kept moist for easy spreading and not allowed to dry out after construction. Use three to five inches of clay. Six to eight inches of topsoil or loamy soil should be spread on top of the clay. This will provide a good substrate for the roots of the wetland plants. Adjust the depth of excavation to allow for the clay liner and soil on top of the liner. If a rubber liner is used, eight to ten inches of soil should be placed on top of the liner. Wetland plants can then be planted directly into the soil. Soil is an integral part of a wetland system.

**Wetland Buffer** - Two general types of buffers can be planted around a wetland. The first is a buffer of trees and shrubs. The second is a grassland/wildflower meadow buffer. If a grassland buffer is planted, a few shrubs should be planted on the wetland edge, as these will provide important habitat for birds and amphibians. The buffer should be a minimum width of 25 feet and wider if space allows.

**Planting Plan** - It is suggested that students complete this exercise, then have their plant list reviewed by a natural resource specialist. Order nursery catalogs from wholesale wetland nurseries for students to use. Select plants native to your site and select wild varieties over cultivars.

Table 5 lists plants by moisture zones native to Maryland and widely available through nurseries. This is not a comprehensive list.

**ZONE 1 Upland**

**shrubs**
Sweet Pepperbush (Clethra alnifolia)
Spicebush (Lindera benzoin)
Highbush Blueberry (Vaccinium Corymbosum)
Arrowwood (Viburnum dentatum)

**trees**
Shadbush (Amelanchier canadensis)
River Birch (Betula nigra)
Hackberry (Celtis occidentalis)
Persimmon (Diospyros virginiana)
Tulip Poplar (Liriodendron tulipifera)
Willow Oak (Quercus phellos)

**ZONE 2 Wetland Edge**

**shrubs**
Smooth Alder (Alnus serrulata)
Buttonbush (Cephalanthus occidnetalis)
Silky Dogwood (Cornus amomum)
Red-osier Dogwood (Cornus stolonifera)
Winterberry (Ilex verticillata)
Elderberry (Sambucus canadensis)

**herbaceous plants**
Swamp Milkweed (Asclepias incarnata)
New England Aster (Aster novae-angliae)
Joe Pye Weed (Eupatorium dubium)
Soft Rush (Juncus effusus)
Cardinal Flower (Lobelia cardinalis)
Switchgrass (Panicum virgatum)
Woolgrass (Scirpus pungens)
New York Ironweed (Vernonia noveboracensis)

**ZONE 3 Shallow Wetland 0-6''**
Sweet Flag (Acorus calamus)
Tussock Sedge (Carex stricta)
Rose Mallow (Hibiscus moscheutos)
Blue Flag (Iris versicolor)
Three Square (Scirpus pungens)
Eastern Bur-reed (Sparganium americanum)

**ZONE 4 Deep Wetland 6-12''**
Pickerelweed (Ponederia cordata)
Duck Potato (Sagittaria latifolia)
Lizards Tail (Saurrus cernuus)
Soft Stem Bulrush (Scirpus tabernaemontani)

Sample Native Plants for Moisture Zones within a Wetland Table 5

## Long Term Maintenance

Monitoring and observing changes over time is the key to making management decisions. It is very helpful to work with a wetland specialist or botanist to provide guidance. The following are some general maintenance guidelines.

- Removing invasive exotic species: Phragmites and purple loosestrife are the two non-native species of concern, although there are others. Cattails, while native, can be very aggressive and should be monitored carefully. Cattails are well adapted to grow in disturbed areas such as stormwater management ponds. In these areas it may be an uphill battle to control cattails as they will return each year. It may be best to let the marsh develop as a cattail marsh.

- Colonization by other plants: Other plants will colonize the site. This is a natural process that will add to the diversity of your habitat. Some may compete with your plants. If the colonizing plants are not invasive, it is best to leave them alone.

- Adding more plants: Some wetland plants spread rapidly; therefore, it may not be necessary to add plants. If you need to add plants, wait until late in the spring after dormant plants have come up to avoid crushing the dormant plants.

- Watering: Upland plants need to be watered for at least the first summer after planting.

- Coordination with maintenance staff: It is essential to let the maintenance staff know where to mow and where not to mow. Un-mowed areas should be marked with stakes or a diagram. One of the single biggest frustrations associated with school habitat projects is new plantings being damaged or killed by mowing.

- Water fluctuation: Many plants adapt to natural fluctuations in water levels. However, if the water either floods too deep or too often, or dries out too much then certain plants may not survive. Therefore, it is important to keep track of which species survive. More often then not, too much water is the cause of plants not surviving. There are other reasons for plants dying such as poor planting technique, poor nursery stock, or disease but water levels play a major role in plant survival.

- Erosion: Watch closely for rills that may develop from moving water especially if a low berm or dam was constructed and overflow water moves through an established swale. Mats of sod can be used to stop erosion in swales. Willow stakes can be used to combat erosion. A low check dam(s) can be constructed to control flow, reduce erosion, and dissipate energy in swales. As a last resort, the swale can be lined with rock.

- Siltation: Through siltation, the depth of the wetland will reduce over time. This is a natural process. Reducing erosion in the drainage area will slow down this process. A decision should be made if and when to remove silt or to let the natural process continue.

- Adding animal species: One of the most common questions about wetland projects is: Should I add fish, frogs, or turtles? There is no need to add your own frogs or turtles (unless your site is in an enclosed area or highly urbanized) as they will find their way to the wetland if it meets their habitat needs. Because many amphibian species only use wetlands to lay eggs, the adults may not be seen. Other species are more water dependent and will inhabit the wetland longer. Fish will unlikely colonize your site unless it is connected to a stream or river system. Since fish eat tadpoles, many species of amphibians will only lay their eggs in wetlands that do not contain fish. The majority of fish species require 4' of water to survive winter freeze and summer heat. Therefore, a decision to include fish will be based on: a) a wetland having a deep area where fish can survive and, b) an interest in providing habitat for fish. Since there is a worldwide decline in many amphibian species, it is recommended not to add fish unless they meet a specific educational goal.

## Cost

The cost of constructing a wetland can vary widely depending on size, amount to be excavated, amount of work, and materials donated. The following list gives some general thoughts about costs:

- Design: On an existing site, the county Soil Conservation Districts are very helpful at completing wetland designs at no cost. The U.S. Fish and Wildlife Service is also available to consult on design. Engineering firms or universities may be able to complete designs at no cost as a public service. Some county public works engineers will provide design assistance. On a new school site, the cost of designing a stormwater wetland should not be significantly more then the typical stormwater management pond.

- Construction: Earth moving can range anywhere from $1.80 to $4.00 or more a cubic yard. Contractors have been very generous in providing excavation at reduced rates or at no cost when approached to excavate a wetland for an existing school site. For new school design, the excavation costs of a good wetland design will be slightly more than a typical stormwater management pond.

- Construction materials: Seed, straw, and erosion control fence shouldn't cost more then a few hundred dollars.

- Plants: For a 1/4 acre wetland site, plants can be purchased for $500 - $1,000. Grants are easily obtained to cover all the costs. Natural colonization of wetland plants will fill in any gaps. In subsequent years, focus on planting a shrub or meadow buffer around the wetland.

The Chesapeake Bay Trust (410-974-2941) and Department of Natural Resources Aquatic Education Program (410-260-8716) can provide funding for plants, educational materials, and possibly construction costs. The U.S. Fish and Wildlife Service Partners for Fish and Wildlife Program (410-573-4500) can provide technical assistance and a limited amount of funding.

## Student Participation

Student participation should be a primary focus of the project as students will take ownership of the wetland if they participate in the planning process. This is especially true for establishing a wetland on an existing site. Some of the ways students can get involved include:

- completing an initial site study,
- sketching a concept design for the size and shape of the wetland,
- selecting plant species,
- developing a planting design,
- installing plants,
- watering plants,
- writing grants,
- soliciting donations from parents and businesses,
- writing a press release, and
- presenting the project to the community and board of education.

Since each project is different, teachers can work with a natural resource specialist to decide how students can be involved. The U.S. Fish and Wildlife Service has developed a guide to help teachers lead their students through the process of planning a wetland. For a copy of this publication call 410-573-4500.

## Safety

Slopes adjacent to and within the wetland should be very gentle. Water depths should be kept under 2 feet. Following these basic guidelines will insure a safe wetland site. Fencing should only be used if required. Fencing isolates the wetland from certain wildlife species. Fencing also sends a confusing message to students about natural areas being dangerous or off limits.

## Other Concerns

**Mosquitoes** - Many mosquito species breed in temporary pools of water that lack larval predators. Established permanent wetlands with aquatic plants have a variety of aquatic insect predators including dragonfly larvae, diving beetles, and water striders that

eat mosquito larvae. A small established wetland will harbor a few more mosquitoes then upland habitat but it should not significantly add to the local mosquito population. If mosquitoes become a major problem, mosquito fish can be added to the wetland. They are available from the Maryland Department of Agriculture.

**Snakes** - Snakes are part of the natural ecosystem that play a key role in the food web both as predators and prey. **There are no poisonous water snakes in Maryland.** The northern extent of the poisonous water moccasin is in the Great Dismal Swamp in Southern Virginia. Young northern water snakes have a banded pattern and have been confused with water moccasins. Northern water snakes can be quite curious and sometimes aggressive. However, they are not harmful and will not bite unless provoked.

**Plants of Concern** - No plant parts should be eaten unless known to be edible. Stinging nettle is a plant that should be removed if found on site. Rice cutgrass (a native wetland plant) should not be planted as the leaves have sharp edges and can cut skin.

## Regulatory Requirements

Wetlands are regulated by Section 404 of the Clean Water Act. A permit is required when a wetland is disturbed or altered. If a site has wetland characteristics (persistent saturated or ponded soil, gray or mottled soil color, and or hydrophytic vegetation such as rushes, sedges, or cattails) invite a representative from the Maryland State Department of the Environment to the site to make a decision on whether a permit is needed. If the site is an upland no permit is necessary. A sediment and erosion control plan is needed if more then 5,000 sq. ft. of soil is disturbed.